

# CRETACEOUS MICROPLANKTON FROM EYRE No. 1 BORE CORE 20, WESTERN AUSTRALIA

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With Introduction by B. S. INGRAM‡

**ABSTRACT:** 28 species assignable to 18 genera including one new genus *Eyrea* and eleven new species are herein recorded from the Eyre Bore No. 1 core 20, between 1,400-1,410 ft, Western Australia. A remarkable feature has been the frequency and number of species of the genus *Pterospermopsis* W. Wetzel 1952, especially *P. aureolata* Cookson and Eisenack 1958.

## INTRODUCTION

Cookson and Eisenack (1970) described assemblages of microplankton from two bores in the Eucla Basin, Western Australia. The present paper extends the work, as it describes assemblages from Exoil Pty. Ltd.'s exploration well Eyre No. 1 drilled in 1959-60 at the geographic co-ordinates—

32°07'S.  
126°58'E.

The sample comes from core 20 (1,400-1,410 ft), and is a dark grey silty mudstone. In a preliminary stratigraphic study using the spores, pollen grains and microplankton from various Cretaceous rocks of the Eucla Basin, Ingram (1968) considered this sample to be Albian-Cenomanian in age.

## SYSTEMATIC DESCRIPTIONS

The registered numbers given for Holotypes and Hypotypes are those of the Palynological Collection of the Geological Survey of Western Australia.

Division PYRRHOPHYTA Pascher 1914

Class DINOPHYCEAE Fritsch 1929

Family GONYAULACYSTACEAE Sarjeant and  
Downie 1966

Genus *Cribroperidinium* Neale and Sarjeant 1962

*Cribroperidinium edwardsi* (Cookson and Eisenack)  
Davey 1969, p. 125

(Pl. 7, fig. 1 F8065)

*Gonyaulax edwardsi* Cookson and Eisenack 1958,  
p. 32, Pl. 3, fig. 5, 6.

*Gonyaulax edwardsi* Cookson and Eisenack, Cookson  
and Hughes 1964, p. 43, Pl. 5, fig. 9.

*Gonyaulax edwardsi* Cookson and Eisenack 1968,  
p. 117, fig. 5A and B.

*Gonyaulax edwardsi* Cookson and Eisenack, Ingram  
1968, p. 65.

*Cribroperidinium edwardsi* Cookson and Eisenack,  
Davey 1969, p. 128.

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

**DIMENSIONS:** Overall length *c.* 162-280  $\mu$ , overall  
breadth *c.* 138-239  $\mu$ .

**COMMENT:** Several specimens which agree in general  
features with *G. edwardsi* from a number of Lower  
and Upper Cretaceous Western Australian deposits  
have been present in residues of the Eyre Bore No. 1  
core 20. However, taken as a whole, they are rather  
larger than those on which the species was based.

Family DEFLANDREACEAE Eisenack 1954

Genus *Deflandrea* Eisenack 1938

*Deflandrea eyrensis* n. sp.

(Pl. 7, fig. 2, 3, Holotype fig. 3 F8066)

**AGE AND OCCURRENCE:** Mid-Cretaceous Eyre Bore  
No. 1 core 20, Western Australia.

**DESCRIPTION:** Shell considerably longer than broad,  
resembling in that respect *D. bakeri* Deflandre and  
Cookson (1955) and *D. scheii* Manum (1963).

Epitheca longer than the hypotheca, dome-shaped  
with a very short centrally-placed apical horn. Hypo-  
theca with convex sides which slant towards a very  
short antapical prominence situated towards the left-  
hand side of the dorsal surface. Girdle circular and

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rather broad (Pl. 7, fig. 3). Wall of shell thin, slightly to rather coarsely and densely granular especially in the upper portion of the epitheca. Capsule relatively large, roughly oval in shape but not reaching the lateral walls of the shell. Surface closely granular varying somewhat in the degrees of density. Archeopyle relatively small, when clearly developed, as in the holotype, six-sided.

**DIMENSIONS:** Holotype—shell *c.*  $90 \mu \times 56 \mu$ , capsule *c.*  $60 \mu \times 60 \mu$ . Range from shell *c.*  $72 \mu \times 45 \mu$ , capsule *c.*  $48 \mu \times 42 \mu$  to shell *c.*  $121 \mu \times 82 \mu$ , capsule *c.*  $80 \mu \times 60 \mu$ .

**COMMENT:** *D. eyrensis* has occurred frequently in preparations of the Eyre deposit core 20. As the illustrations show, a considerable degree of variation both in the density and coarseness of the ornament of the shell occurs.

**Deflandrea ingrami** Cookson and Eisenack 1970a  
(Pl. 7, fig. 4)

*Deflandrea ingrami* Cookson and Eisenack 1970a, p. 143, Pl. 12, fig. 7-9.

**DIMENSIONS:** Figured specimen *c.*  $84 \mu$  long, *c.*  $67 \mu$  broad. Range *c.*  $62-95 \mu$  long, *c.*  $50-70 \mu$  broad.

**COMMENT:** *D. ingrami*, a common constituent of the Senonian portion of the Madura No. 1 Bore, Western Australia, is also relatively frequent in the Mid-Cretaceous Eyre sample. As in the Madura examples, the surface thickenings vary in clearness and prominence and the archeopyle is six-sided.

? Genus **Ascodinium** Cookson and Eisenack 1960

? **Ascodinium trendalli** Cookson and Eisenack 1970a  
(Pl. 7, fig. 5, 6 F8067)

? *Ascodinium trendalli* Cookson and Eisenack 1970a, p. 145, Pl. 12, fig. 5, 6.

**AGE AND OCCURRENCE:** Senonian, Albian-Cenomanian: Madura No. 1 Bore, Western Australia, 1,018-1,072 ft and 1,073-1,104 ft. Mid-Cretaceous, Eyre No. 1 Bore core 20, Western Australia.

**DIMENSIONS:** *c.*  $62-88 \mu$  long, *c.*  $50-70 \mu$  broad (16 specimens measured).

**COMMENT:** As in the many examples of this species from the Madura Bore (Cookson and Eisenack 1970a), the numerous comparable specimens from the Eyre Bore sample have shown no sign of an archeopyle. For this reason we regard the generic assignment to *Ascodinium*, adopted previously and herein, as doubtful. The Eyre specimens agree in general features with those from the Madura Bore but the walls of their capsules are distinctly thinner and the shells somewhat broader than those from the latter locality. Individual specimens have varied considerably as to the degree of ornamentation. The occurrence of the wavy thickening on the ventral surface of the hypotheca, which we believe to have been associated with the flagellum has been, as in the Madura examples and many other types (Cookson and Eisenack 1970a, p. 153), constantly present.

Family **MICRODINIACEAE** Eisenack 1964

Genus **Microdinium** Cookson and Eisenack 1960  
emend Sarjeant 1966, p. 148

**Microdinium ornatum** Cookson and Eisenack 1960  
(Pl. 7, fig. 7, 8, 9, fig. 7 F8068, fig. 8-9 F8069)

*Microdinium ornatum* Cookson and Eisenack 1960, p. 6, Pl. 2, fig. 3-8, text fig. 2-4.

*Microdinium ornatum* Manum and Cookson 1964, p. 19, Pl. 19, fig. 8-10.

*Microdinium cf. ornatum* Sarjeant 1966, 'Studies', p. 149, Pl. 16, fig. 3-6, text fig. 38.

*Microdinium ornatum* Clarke and Verdier 1967, p. 66, Pl. 5, fig. 11-14.

*Microdinium cf. ornatum* Davey 1969, p. 132, Pl. 4, fig. 5, text fig. 13C. F.

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia, and several other Albian-Cenomanian Western Australian deposits (Cookson and Eisenack 1960).

**DIMENSIONS:** Figured specimen (Pl. 7, fig. 8, 9) *c.*  $42 \mu$  long, *c.*  $34 \mu$  broad. Range *c.*  $33-54 \mu$  long, *c.*  $38-48 \mu$  broad.

**COMMENT:** Several specimens which agree well both in tabulation and ornamentation with the type specimens have been recovered from the Eyre residues. The ones illustrated are distinctly larger and the borders of the plates and their bead-like supports more prominent than those of the type specimens from Western Australian Lower and Middle Cretaceous deposits. However, there is little doubt that the Eyre specimens are closely related to *M. ornatum*. The mode of opening of the shell by the removal of the apical plate is well shown in Pl. 7, fig. 7, 8.

**Microdinium veligerum** (Deflandre) Davey 1969  
(Pl. 7, fig. 10)

*Microhystridium veligerum* Deflandre 1937, p. 81, Pl. 12, fig. 9.

*Ceratocorys veligera* (Deflandre) Lejeune-Carpentier 1943, 67: p. 22, text fig. 1-6.

*Eisenackia crassitabulata* (Deflandre) Clarke and Verdier 1967, 24: No. 3, p. 64, Pl. 8, fig. 4-6.

*Microdinium veligerum* (Deflandre) Davey 1969, p. 136, Pl. 3, fig. 4, Pl. 4, fig. 4.

**COMMENT:** Three examples referable to *M. veligerum* have been recovered from the Eyre Bore No. 1 core 20. The one illustrated Pl. 7, fig. 10 is *c.*  $40 \mu$  long and *c.*  $38 \mu$  broad.

**Microdinium** sp.

(Pl. 7, fig. 11 F 8070)

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

**DIMENSIONS:** *c.*  $33 \mu$  long, *c.*  $33 \mu$  broad.

**COMMENT:** The genus *Microdinium* is represented by what appears to be a third species in which an ornamentation is scarcely visible. However, more examples will be needed for the specific placing of this form.

Family HYSTRICHOSPHAERACEAE O. Wetzel  
emend Evitt 1963

Genus *Hystrichosphaera* O. Wetzel 1933, restr.  
Deflandre 1937

*Hystrichosphaera ramosa* (Ehrenberg 1838) var.  
*ramosa* Davey & Williams 1966  
(Pl. 8, fig. 1, 2 F 8071, F 8072)

*Xantlium ramosum* Ehrenberg 1938, 1: pp. 109-136,  
Pl. 1, fig. 15.

*Hystrichosphaera ramosa* (Ehr.) O. Wetzel 1933,  
p. 78, Pl. 5, fig. 7, 8, 10-12, 18, 19.

*Hystrichosphaera ramosa* (Ehr.) Lejeune-Carpentier  
1937, p. 6, Pl. 5, fig. 1, 2.

*Hystrichosphaera ramosa* (Ehr.) Deflandre and Cook-  
son 1955, p. 263, Pl. 2, fig. 1, Pl. 5, fig. 6, Pl. 6, fig. 1.

*Hystrichosphaera ramosa* (Ehr.) var. *ramosa* Davey  
and Williams 1966, 3: p. 33, Pl. 1, fig. 1-6.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

DIMENSIONS OF 9 SPECIMENS: Shell length *c.* 52-87  $\mu$ ,  
breadth *c.* 47-76  $\mu$ . Overall length *c.* 84-146  $\mu$ , overall  
breadth *c.* 76-133  $\mu$ , appendages *c.* 28  $\mu$  long.

COMMENT: Nine examples of this species have been  
mounted from the Eyre Bore No. 1 core 20 residues  
and more have been seen. All agree in shape, distribu-  
tion and form of the appendages of this species but  
are larger than those of the previously recorded  
examples.

In the shape and relative length of the appendages  
they agree best with the figures given by Lejeune-  
Carpentier 1937, Pl. 2. The appendages are definitely  
bifurcate.

Family AREOLIGERACEAE Evitt 1962

Genus *Cyclonephelium* Deflandre and Cookson 1955  
emended, Cookson and Eisenack 1962b

*Cyclonephelium membraniphorum* Cookson and  
Eisenack 1962

(Pl. 8, fig. 3 F 8073)

*Cyclonephelium compactum* Deflandre and Cookson  
1955, p. 285; Cookson and Eisenack 1958, p. 48,  
Pl. 12, fig. 8.

*Cyclonephelium membraniphorum* Cookson and  
Eisenack 1962b, p. 495, Pl. 6, fig. 8-14.

*Cyclonephelium membraniphorum* Cookson and  
Eisenack 1968, p. 120.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

COMMENT: The example figured herein is closely  
comparable with the ones shown by Cookson and  
Eisenack 1962b, Pl. 6, fig. 11, from Wapet's seismic  
shot hole B1, Western Australia, at 210 ft and in  
1968 from the Gingin Brook No. 4 Borehole core 2,  
between 404 and 414 ft, Western Australia.

*Cyclonephelium reticulosum* Gerlach 1961

(Pl. 8, fig. 4 F 8074)

*Cyclonephelium reticulosum* Gerlach 1961, Abh. 112,  
p. 204.

*Cyclonephelium reticulosum* Gerlach, Cookson and  
Eisenack 1967, p. 251, Pl. 41, fig. 5, 6.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

COMMENT: *Cyclonephelium reticulosum* is represented  
by several well-preserved specimens, the apices of  
which seem to be somewhat finer than those of the  
holotype from a West German Oligocene deposit  
(Gerlach 1961).

Family CANNINGIACEAE Sarjeant and Downie  
1962b

Genus *Canningia* Cookson and Eisenack 1960  
*Canningia circularis* n. sp.

(Pl. 8, fig. 6 F 8076)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

DIMENSIONS: Holotype *c.* 90  $\mu$  long, *c.* 107  $\mu$  broad.  
Range: breadth *c.* 83-107  $\mu$ .

DESCRIPTION: Shell flat, almost circular to slightly  
oval in outline, the longitudinal axis somewhat shorter  
than the breadth, without tabulation and prominences.  
Surface densely covered with short, broadly-based,  
pointed tubercles. The shell opens by the detachment  
of the central portion of the apex.

COMMENT: *C. circularis* occurs frequently in the Eyre  
deposit. It is close to *C. ringnessi* Manum and Cook-  
son 1964 but differs from that species in the absence  
of an apical prominence and the coarser ornamenta-  
tion of the shell.

*Cyclonephelium distinctum* Deflandre and Cookson  
1955 emended Cookson and Eisenack 1962b

(Pl. 8, fig. 5 F 8075)

*Cyclonephelium distinctum* Deflandre and Cookson  
1955, p. 285, Pl. 2, fig. 14.

*Cyclonephelium distinctum* Deflandre and Cookson,  
Gocht 1959, p. 77, Pl. 4, fig. 16-18.

*Circulodinium deflandrei* Alberti 1961, p. 29, Pl. 4,  
fig. 7-13.

*Cyclonephelium distinctum* Deflandre and Cookson,  
Cookson and Eisenack 1962b, p. 494, Pl. 5, fig. 4-11.

*Cyclonephelium distinctum* Deflandre and Cookson,  
Cookson and Eisenack 1968, p. 120, fig. 4F.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

DIMENSIONS: Figured specimen overall measurement  
*c.* 128  $\mu$   $\times$  124  $\mu$ .

COMMENT: *C. distinctum* is represented by a number  
of rather large specimens, the ornamentation of which  
has varied considerably. The appendages have been  
either rather short and only slightly broadened at the  
apex or forked or, as in the example illustrated, rather  
long and distinctly forked.

Family HYSTRICHOSPHAERIDIACEAE Evitt 1963  
emend Sarjeant and Downie 1966

Genus *Oligosphaeridium* Davey and Williams 1966  
*Oligosphaeridium pulcherrimum* (Deflandre and  
Cookson) Davey and Williams 1966

(Pl. 8, fig. 7 F8077)

*Hystrichosphaeridium pulcherrimum* Deflandre and  
Cookson 1955, p. 270, Pl. 1, fig. 8, text fig. 21, 22.

*Hystrichosphaeridium pulcherrimum* Deflandre and  
Cookson 1955, Valensi 1955, p. 593, Pl. 4, fig. 1.

*Oligosphaeridium pulcherrimum* (Deflandre and  
Cookson) Davey and Williams 1966, p. 75, Pl. 10,  
fig. 9, Pl. 11, fig. 5, p. 114, fig. 4E.

COMMENT: It is of interest that the dimensions of the  
specimens from the Eyre Bore No. 1 core 20 are  
larger than those given previously. The measurements  
of three of those examined are: (1) shell c.  $80 \times 82 \mu$ ,  
overall c.  $162 \times 162 \mu$  complete with 11 appendages;  
(2) shell c.  $68 \times 76 \mu$ , overall c.  $162-176 \mu$   
with an archeopyle; (3) shell c.  $104 \times 94 \mu$ , overall  
c.  $171 \times 182 \mu$  complete.

Genus *Cleistosphaeridium* Davey, Downie, Sarjeant  
and Williams 1966, p. 170

Cf. *Cleistosphaeridium polytrichum* (Valensi 1947)

(Pl. 11, fig. 10 F8102)

*Hystrichosphaeridium polytrichum* Valensi 1947, p.  
818, fig. 4.

*Hystrichosphaeridium polytrichum* Valensi 1947, De-  
flandre and Cookson 1955, p. 272, Pl. 2, fig. 2.

*Cleistosphaeridium polytrichum* (Valensi 1947) Davey,  
Downie, Sarjeant and Williams 1966, p. 170.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20, Western Australia.

DIMENSIONS: Diameter of shell c.  $40 \mu$ , overall  
diameter c.  $54 \mu$ .

COMMENT: The figured specimen is the only one of  
its kind isolated from the Eyre Bore No. 1 core 20.  
It shows no sign of an archeopyle so that a definite  
assignment to *C. polytrichum* cannot be made.

Family EXOCHOSPHAERIDIACEAE Sarjeant and  
Downie 1966

? Genus *Exochosphaeridium* Davey, Downie, Sarjeant  
and Williams 1966

? *Exochosphaeridium* aff. *striolatum* (Deflandre 1937a)  
(Pl. 11, fig. 11 F8013)

*Hystrichosphaeridium striolatum* Deflandre 1937a, p.  
72, Pl. 15, fig. 1, 2.

*Exochosphaeridium striolatum* (Deflandre 1937a)  
Davey 1969, p. 165.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20.

DIMENSIONS: Overall diameter c.  $46 \mu$ , central body  
c.  $35 \mu$ , spines c.  $7-10 \mu$  long.

COMMENT: The figured specimen, the only one of its  
kind recovered from the Eyre Bore sample, seems to  
have some affinity with the genus *Exochosphaeridium*

and in particular with *E. striolatum* (Deflandre)  
Davey 1969. It is of interest in that there is an indica-  
tion of an apical archeopyle.

Family MEMBRANILARNACIACEAE Eisenack 1963

Genus *Chlamydophorella* Cookson and Eisenack 1958

*Chlamydophorella nyei* Cookson and Eisenack 1958

(Pl. 9, fig. 1 F8078)

*Chlamydophorella nyei* Cookson and Eisenack 1958,  
p. 56.

DIMENSIONS: Figured example overall length c.  $62 \mu$ ,  
overall breadth c.  $52 \mu$ .

COMMENT: The occurrence of *C. nyei* in the Eyre  
Bore core 20 under consideration is not surprising  
since this species has been recorded from a relatively  
large number of Western Australian deposits which  
range in age from Lower to Upper Cretaceous (Cook-  
son and Eisenack 1958, p. 56). The Eyre Bore speci-  
men, illustrated herein, is lying laterally and thus  
shows very clearly the apical projection of the shell  
referred to in the original description.

*Chlamydophorella* sp.

(Pl. 9, fig. 2, 3 F8079, F8080)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20.

DIMENSIONS: Specimen on Pl. 9, fig. 2, overall dimen-  
sion c.  $42 \times 38 \mu$ , shell c.  $37 \times 29 \mu$ . Range, overall  
diameter c.  $30 \times 44 \mu$ , length of appendages c.  $1-5 \mu$ .

COMMENT: The examples from the Eyre Bore herein  
referred to as *Chlamydophorella* sp. seem to be close  
to the ones referred to by Deflandre and Cookson as  
*Hystrichosphaeridium fimbriatum* (White) Deflandre  
from the Lower Cretaceous deposit on Onepah Sta-  
tion, New South Wales (Deflandre and Cookson 1955,  
Pl. 2, fig. 4). However, the appendages of the Eyre  
examples appear to be shorter, more densely arranged  
and in side view to be joined terminally.

Family Incerta

? Genus *Operculodinium* Wall 1967

The following two forms are only provisionally  
referred to the genus *Operculodinium* since in them  
an archeopyle has not, as yet, been observed.

? *Operculodinium punctatum* n. sp.

(Pl. 9, fig. 6, Holotype F8082)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20.

DIMENSIONS: Holotype, diameter c.  $48 \mu$ , height of  
tubercles less than  $1 \mu$ .

DESCRIPTION: Shell spherical, closely covered with  
minute tubercles the bases of which are distinctly  
circular in outline. An archeopyle has not been  
observed.

? *Operculodinium rarispinosum* n. sp.

(Pl. 9, fig. 7, 8, Holotype F8083, Paratype F8084)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore  
No. 1 core 20.

**DIMENSIONS:** Holotype fig. 7, overall diameter c. 59  $\mu$ , diameter of shell c. 55  $\mu$ , length of spines, c. 1-1.5  $\mu$ . Range, diameter of shell c. 32-55  $\mu$ , spines c. 1-2  $\mu$  long.

**DESCRIPTION:** Shell spherical, rather thick-walled, covered with somewhat sparsely distributed short, bluntly-pointed, solid spines. An archeopyle has not been observed.

### Group ACRIARCHA Evitt 1963

#### Sub-group DINETROMORPHITAE Downie, Evitt and Sarjeant 1963

#### Family DIPLTESTACEAE Cookson and Eisenack

##### Genus *Diplofusa* Cookson and Eisenack 1960

##### *Diplofusa gearlensis* Cookson and Eisenack 1960

(Pl. 9, fig. 4)

*Diplofusa gearlensis* Cookson and Eisenack 1960, p. 10, Pl. 3, fig. 10.

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

**DIMENSIONS:** Overall length c. 142  $\mu$ , breadth c. 38  $\mu$ , inner body c. 115  $\times$  32  $\mu$ .

**COMMENT:** The figured specimen agrees in all features with the Holotype from the Cenomanian Upper Gearle Siltstone, Western Australia, Wapet's Rough Range South Bore, core 68, 2,715-2,717 ft. In addition a circular pylome of about 20  $\mu$  diameter seems to be indicated at the apical end of the shell, a feature not previously reported.

#### Sub-group HERCOMORPHITAE Downie, Evitt and Sarjeant 1963

#### Family CYMATIOSPHAERACEAE Maedler 1963

##### Genus *Cymatiosphaera* O. Wetzel 1933 emend Deflandre 1954

##### *Cymatiosphaera tremaphora* n. sp.

(Pl. 9, fig. 12-14, Holotype fig. 12 F8087, Paratype fig. 13 F8088)

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20.

**DIMENSIONS:** Holotype, Pl. 9, fig. 12, diameter of shell c. 48  $\mu$ , overall diameter c. 52  $\mu$ , wall c. 2-3  $\mu$ . Range of 16 specimens: Shell c. 25-52  $\mu$ , overall c. 30-57  $\mu$ .

**DESCRIPTION:** Shell relatively thick-walled provided with low clearly-defined ledges which, by their union, form numerous 4-6-sided polygonal areas the outlines of which may be slightly wavy. At the angular points where the ledges of adjacent areas join, minute unthickened areas are sometimes evident (Pl. 9, fig. 13, 14). In the specimen illustrated on Pl. 9, fig. 14, a small circularly outlined, centrally-placed raised area is indicated in three of the fields, to the left of the middle of the shell. These areas closely resemble those present in the holotype of *C. stigmata* Cookson and Eisenack 1958, Pl. 9, fig. 14.

The number of polygons in one half-sphere of

specimens of normal size is about 25. In median optical section there are about 15-20 ledges placed around the circumference.

##### *Cymatiosphaera delicata* n. sp.

(Pl. 10, fig. 12-14, Holotype fig. 13 F8097)

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

**DIMENSIONS:** Holotype (Pl. 4, fig. 13): Shell diameter c. 60  $\mu$ , overall diameter c. 67  $\mu$ , wall c. 3  $\mu$ . Range: Diameter of shell c. 52-78  $\mu$ , overall diameter c. 60-94  $\mu$ , wall c. 2-3  $\mu$ , ledges c. 4-7  $\mu$ . Six specimens measured.

**DESCRIPTION:** Shell relatively large with a thickish wall and delicate high ledges which form rather large 5- or 6-sided polygons the number of which on one half-sphere is about six or seven. No pylome has been observed.

##### *Cymatiosphaera* sp.

(Pl. 9, fig. 9-11, fig. 10 F8085, fig. 11 F8086)

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20.

**DIMENSIONS:** Fig. 11, diameter of shell c. 25  $\mu$ , overall diameter c. 30  $\mu$ . Fig. 9, 10, two views of the same specimen. Shell c. 33  $\mu$ , overall diameter c. 40  $\mu$ .

**COMMENT:** A few considerably smaller specimens with fewer ledges than those of *C. tremaphora* (Pl. 9, fig. 12-14) have been met with. For example the exposed surface of the specimen shown on Pl. 9, fig. 9, has c. 22 fields with ledges c. 2-5  $\mu$  in height, the one on Pl. 9, fig. 11, has c. 14 fields of approximately the same height. At present it is not possible to know whether or not such specimens represent young stages in the development of *C. tremaphora* or a fully developed and distinctive type.

#### Sub-group PTEROMORPHITAE Downie, Evitt and Sarjeant 1963

#### Family PTEROSPERMOPSISACEAE Eisenack 1954

##### Genus *Pterospermopsis* W. Wetzel 1952

##### *Pterospermopsis aureolata* Cookson and Eisenack 1958

(Pl. 10, fig. 1-3 F8089, F8090)

*Pterospermopsis aureolata* Cookson and Eisenack 1958, p. 49, Pl. 9, fig. 9-13.

**AGE AND OCCURRENCE:** Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

**DIMENSIONS:** Overall diameter c. 57-235  $\mu$ , shell c. 32-128  $\mu$ . Overall diameter of small example (Pl. 10, fig. 3) c. 33  $\mu$ .

**COMMENT:** Specimens of this species, originally described and recorded from a relatively large number of Cretaceous deposits in Western Australia, South Australia and Queensland (Cookson and Eisenack 1958, p. 49) have been recovered from the Eyre No. 1 Bore core 20. The range in size agrees well with that given in the original description. Large or moderately large specimens of *P. aureolata* are readily recognizable, but the relationships of some smaller ones of

similar construction are more difficult to determine (Pl. 7, fig. 3). It is possible that such specimens could represent either young stages of *P. aureolata* or a distinct species. More specimens will be needed to settle this question. The wing of *P. aureolata* is two-layered, a feature best seen in broken examples.

*Pterospermopsis australiensis* Deflandre and Cookson  
1955

(Pl. 10, fig. 4-6, fig. 5 F8091, fig. 6 F8092)

*Pterospermopsis australiensis* Deflandre and Cookson 1955, p. 286, fig. 52, 53, Pl. 3, fig. 4.

*Pterospermopsis helios* Sarjeant 1959, p. 342, Pl. 13, fig. 9.

*Pterospermopsis australiensis* Deflandre and Cookson 1955, Stanley, J. A. 1965, p. 234, Pl. 23, fig. 8, 9.

AGE AND OCCURRENCE: Lower Cretaceous: Onepah Station, New South Wales. Mid-Cretaceous: Eyre Bore No. 1 core 20, Western Australia.

DIMENSIONS: Diameter of shell c. 10-26  $\mu$ , overall diameter c. 25-53  $\mu$ .

COMMENT: A number of specimens, fundamentally comparable with *P. australiensis* Deflandre and Cookson from Onepah Station, New South Wales, have been recovered from residues of the Eyre No. 1 Bore core 20. All have shown very clearly the radial folds in the wing of the shell, mentioned by Deflandre and Cookson 1955, p. 286 in the original description of this species, and shown in the illustration of the type specimen, Pl. 9, fig. 4. On this account, therefore, there seems to be no justification for the separation of the better preserved Eyre specimens from *P. australiensis* nor for the formation of the new species *P. helios* Sarjeant (1959) from the Upper Jurassic Cornbrash of Yorkshire.

A feature not mentioned by Deflandre and Cookson or by Sarjeant is the presence in a few of the Eyre Bore specimens (Pl. 10, fig. 5, 6) of a small circular thickening in the centre of one side of the shell.

*Pterospermopsis centrata* n. sp.

(Pl. 10, fig. 7, 8, Holotype fig. 7 F8093)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

DIMENSIONS: Holotype fig. 7, overall diameter c. 66  $\mu$ , shell c. 35  $\mu$ , ventral thickening c. 20  $\mu$ . Range: Overall diameter c. 60-66  $\mu$ , diameter of shell c. 32-35  $\mu$ , central thickening c. 18-20  $\mu$ .

DESCRIPTION: The holotype, which is circular in outline, consists of a relatively wide and thick outer wing-like layer and an inner portion which probably represents the shell proper. The latter consists of a series of zones, the outermost of which is the widest and most delicate. The centre of the shell is occupied by a thick-walled circular body with a small round and solid central area, very similar to the one present in *Pterospermopsis australiensis*.

*Pterospermopsis zonaria* n. sp.

(Pl. 10, fig. 9, 10, Holotype fig. 9 F8095)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20.

DIMENSIONS: Holotype, overall diameter c. 46  $\mu$ , shell c. 17  $\mu$ . Range of overall diameter: c. 32-65  $\mu$ .

DESCRIPTION: Specimens flat, circular in outline with indications of several concentric layers and apparently composed, as in other species of *Pterospermopsis*, of a central shell and an equatorial wing. However, in this species, without a cross-section through the centre it is not possible to determine the actual limits of the shell and wing.

*Pterospermopsis eurypteris* Cookson and Eisenack  
1958

(Pl. 10, fig. 11)

*Pterospermopsis eurypteris* Cookson and Eisenack 1958, p. 49, Pl. 9, fig. 9, 13.

*Pterospermopsis eurypteris* Cookson and Eisenack, Alberti 1961, p. 40, Pl. 11, fig. 10.

COMMENT: Three specimens which seem referable to *P. eurypteris* have been recovered from the Eyre Bore sample 20, the main distinction being one of size. For example, the overall diameter of the three Eyre specimens recovered range from c. 58-72  $\mu$  and the diameter of the shell between c. 24  $\mu$  and c. 28  $\mu$ , whereas the overall diameter of the original examples of *P. eurypteris*, from Western and South Australian Lower Cretaceous deposits, ranged from between c. 95  $\mu$  and c. 123  $\mu$  and the shells between c. 36  $\mu$  and c. 49  $\mu$ .

Sub-group Uncertain

Genus *Palaeostomocystis* Deflandre 1935

*Palaeostomocystis pachythea* n. sp.

(Pl. 11, fig. 7-9, Holotype fig. 8 F8109, Paratype fig. 7 P8110)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20.

DIMENSIONS: Holotype c. 34  $\times$  35  $\mu$ . Range: c. 28-35  $\mu$ . Wall of shell c. 2-5  $\mu$  thick.

DESCRIPTION: Shell small, circular to slightly oval in outline, smooth, unornamented and typically thick-walled. Opening by the detachment of the whole apical wall of the shell.

COMMENT: The Eyre Bore specimens, herein tentatively referred, as a new species, to the genus *Palaeostomocystis*, appear to be somewhat similar to the specimens from Pleistocene Peats in Staffordshire, England, referred by Sarjeant and Strachan 1968 to the genus *Leiosphaeridia* Eisenack 1958 emend Downie and Sarjeant 1963. However, the Eyre specimens differ from *L. telmaticum* Sarjeant and Strachan in the somewhat larger size of the shell, the greater thickness of the wall and the wider and more strongly outlined opening. The example shown in Pl. 5, fig. 9 has a thinner wall and may, possibly, represent a distinct species of *Palaeostomocystis*.

Group and Family Incerta

*Enigmasphaera eyrensis* n. gen. n. sp. F8081

(Pl. 9, fig. 5)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

DIMENSIONS: Overall shell c. 90  $\mu \times$  95  $\mu$ .

DESCRIPTION: Shell roughly circular in outline, with

four marginal concavities which mark the limits between the four large areas into which one surface of the shell is delimited by somewhat thickened, slanting and entire lines which extend from the centre of the wall to the outer margins. On the opposite surface, four areas are also evident; two large ones square in outline and two smaller ones which, unfortunately, are less clearly delimited. All four are outlined by small closely arranged dot-like thickenings. The general surface of the shell is otherwise completely smooth and unornamented and its wall is moderately thick.

COMMENT: Only one specimen has been found. There is no evidence that the shell was hollow.

### Class Fossil CHLOROPHYTA

#### ? Order VOLVACALES Oltmanns 1904

#### Family LECANIACEAE Cookson and Eisenack 1970b

DIAGNOSIS: 'Shell single-layered, circular to slightly oval in outline, which when mature, apparently separates into two half-spheres each of which is flat and widely open on one side; with or without ornamentation and with or without a thin wing'.

Type Genus *Lecaniella* Cookson and Eisenack 1962a, p. 270

Genus *Eyrea* Cookson and Eisenack 1970b, p. 322

DIAGNOSIS: 'Shell circular to slightly oval in outline, smooth or finely granular, surrounded by a thin, hyaline wing which is indistinctly and irregularly delimited. Usually the two half-shells occur as individual units only occasionally side by side in pairs' as in Pl. 11, fig. 3, 5. Type species *Eyrea nebulosa* n. sp.

*Eyrea nebulosa* n. sp.

(Pl. 11, fig. 2-6, Holotype fig. 2 F8099, Paratypes fig. 9 F8100 and fig. 11 F8101)

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20.

DIMENSIONS: Holotype: Shell c.  $51 \mu \times 50 \mu$ , overall diameter c.  $65 \mu$ . Range of shells: c.  $33-52 \mu$ .

DESCRIPTION: Shell circular to slightly oval in outline, smooth or very finely and indistinctly granular, surrounded by a thin, hyaline wing which is indistinctly and irregularly delimited and occasionally finely and radially striated. Sometimes the outermost rim of the shell seems to be tilted over and, due to compression, appears as a narrow double zone. Usually the two half-shells occur as individual units, only occasionally side by side in pairs (Pl. 11, fig. 3, 5).

*Eyrea* sp.

(Pl. 11, fig. 1 F8098)

DIMENSIONS: Shell c.  $140 \mu \times 119 \mu$ , wing c.  $218 \mu \times 166 \mu$ .

COMMENT: The figured half-shell, the only one of its kind found, suggests that a second species of this genus may have occurred in the Eyre deposit. It is much larger than specimens of *E. nebulosa* and the shell is distinctly granular.

#### ? Order PROTOCOCCALES Manum & Cookson 1964

#### Family Uncertain

Genus *Palambages* O. Wetzel 1961

*Palambages* cf. Form A Manum and Cookson 1964

(Pl. 11, fig. 12 F8104)

*Palambages* Form A Manum and Cookson 1964, p. 24, Pl. 7, fig. 3-6.

*Palambages* Form A Manum and Cookson, Cookson 1965, p. 91, Pl. 11, fig. 5, 6.

AGE AND OCCURRENCE: Mid-Cretaceous, Eyre Bore No. 1 core 20, Western Australia.

DIMENSIONS: Overall diameter c.  $45-90 \mu$ , individual cells c.  $22-24 \mu$ , number per colony c. 8-100.

COMMENT: The Eyre examples of *Palambages* agree closely with those of Form A from Graham and Ellef Ringes Island (Manum and Cookson 1964) and Upper Cretaceous deposits in Eastern Australia (Cookson 1965). In all the Australian specimens the walls of the shells have been thin 'smooth or very finely granular in surface view'.

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## EXPLANATION OF PLATES 7-11

## PLATE 7

- FIG. 1—*Cribroperidium edwardsi* (Cookson and Eisenack) Davey 1969, p. 125,  $\times$  c. 280.  
 FIG. 2-3—*Deflandrea eyrensis* n. sp. Fig. 2, Paratype,  $\times$  c. 550; Fig. 3, Holotype,  $\times$  c. 550.  
 FIG. 4—*Deflandrea ingranni* Cookson and Eisenack 1970a,  $\times$  c. 550.  
 FIG. 5-6—? *Ascodinium trendalli* Cookson and Eisenack 1970a,  $\times$  c. 750.  
 FIG. 7-9—*Microdinium ornatum* Cookson and Eisenack 1960,  $\times$  c. 750.  
 FIG. 10—*Microdinium veligerum* (Deflandre) Davey 1969,  $\times$  c. 700.  
 FIG. 11—*Microdinium* sp.,  $\times$  c. 700.

## PLATE 8

- FIG. 1-2—*Hystrichosphaera ramosa* (Ehrenberg 1838) var. *ramosa* Davey and Williams 1966,  $\times$  c. 350.  
 FIG. 3—*Cyclonephelium membraniphorum* Cookson and Eisenack 1962,  $\times$  c. 250.  
 FIG. 4—*Cyclonephelium reticulosum* Gerlach 1961,  $\times$  c. 350.  
 FIG. 5—*Cyclonephelium distinctum* Deflandre and Cookson 1955, emend Cookson and Eisenack 1962b.  
 FIG. 6—*Canningia circularis* n. sp. Holotype,  $\times$  c. 500.  
 FIG. 7—*Oligosphaeridium pulcherrimum* (Deflandre and Cookson) 1955, Davey and Williams 1966,  $\times$  c. 300.

## PLATE 9

- FIG. 1—*Chlamydothorella nyei* Cookson and Eisenack 1958,  $\times$  c. 750.  
 FIG. 2, 3—? *Chlamydothorella* sp. Fig. 2,  $\times$  c. 800; Fig. 3,  $\times$  c. 600.  
 FIG. 4—*Diplofusa gearlensis* Cookson and Eisenack 1960,  $\times$  c. 400.  
 FIG. 5—*Eyreasphaera enigmatica* n. gen., n. sp.,  $\times$  c. 375.  
 FIG. 6—? *Operculodinium punctatum* n. sp. Holotype,  $\times$  c. 500.  
 FIG. 7, 8—? *Operculodinium rarispinosum* n. sp. Fig. 7, Holotype,  $\times$  c. 700; Fig. 8, Paratype,  $\times$  c. 1,000.  
 FIG. 9, 11—*Cymatiosphaera* sp. Fig. 9, 10 two views of the same specimen,  $\times$  c. 550; Fig. 11,  $\times$  c. 700.  
 FIG. 12-14—*Cymatiosphaera tremaphora* n. sp.,  $\times$  c. 700. Fig. 12, Holotype; Fig. 13, Paratype.

## PLATE 10

- FIG. 1-3—*Pterospermopsis aureolata* Cookson and Eisenack 1958. Fig. 1,  $\times$  c. 250; Fig. 2, 3,  $\times$  c. 700.  
 FIG. 4—*Pterospermopsis* cf. *australiensis* Deflandre and Cookson 1955.  
 FIG. 5, 6—*Pterospermopsis australiensis* Deflandre and Cookson 1955,  $\times$  c. 380.  
 FIG. 7, 8—*Pterospermopsis centrata* n. sp. Fig. 7, Holotype,  $\times$  c. 330; Fig. 8,  $\times$  c. 670.  
 FIG. 9, 10—*Pterospermopsis zonaria* n. sp. Fig. 9, Holotype,  $\times$  c. 670; Fig. 10,  $\times$  c. 670.  
 FIG. 11—*Pterospermopsis eurypteris* Cookson and Eisenack 1958,  $\times$  c. 670.  
 FIG. 12-14—*Cymatiosphaera delicata* n. sp. Fig. 12-14,  $\times$  c. 550; Fig. 13, Holotype.

## PLATE 11

- FIG. 1—*Eyrea* sp.,  $\times$  c. 285.  
 FIG. 2-6—*Eyrea nebulosa* n. sp. Fig. 2, Holotype,  $\times$  c. 800; Fig. 3-4, 6,  $\times$  c. 570; Fig. 5,  $\times$  c. 240.  
 FIG. 7-9—*Palaeostomocystis pachythea* n. sp.,  $\times$  c. 750. Fig. 8, Holotype.  
 FIG. 10—*Cleistosphaeridium* cf. *polytrichum*,  $\times$  c. 600.  
 FIG. 11—? *Exosphaeridium* affinity *striolatum*,  $\times$  c. 800.  
 FIG. 12—*Palambages* cf. Form A Manum and Cookson,  $\times$  c. 650.